

Indoor air quality (IAQ) refers to the content of interior air that can affect the health, safety and comfort of people living or working in buildings or confined places. Indoor air can be polluted by a wide range of toxic chemical contaminants – including gases, vapours and dusts – as well as by biological contaminants such as moulds, viruses and dust mites.

Contrary to popular expectations, indoor air can be far more polluted than outdoor air even in big cities, as the occupants of the modern buildings – which are often tightly sealed in order to air condition them, or against extremes of heat and cold outside – are then fully exposed to whatever pollutants build up in the air they breathe.

Most Australians spend an average of 90% of their time indoors, sometimes more, so the quality of indoor air has major implications for their health and wellbeing. The difference in public awareness of indoor and outdoor air pollution may be due to the fact that ‘smog’ is usually easily visible, whereas contaminated indoor air is not.

Health impacts

The World Health Organisation estimates that 2.4 million people die each year from air pollution, and of these fatalities the majority – 1.5 million – are attributed to indoor air pollution.

Direct causes of air pollution-related deaths include aggravated asthma, bronchitis, emphysema, lung and heart diseases and respiratory allergies. It also kills patients suffering from cystic fibrosis and COPD (chronic obstructive pulmonary disease) and other forms of impaired lung function more quickly. Indirect causes of air pollution can be very hard to trace, but include cancers and chronic ailments resulting from continual exposure to a cocktail of toxic compounds. Other common health problems that result from exposure to poor indoor air quality include irritation of the skin, eyes and nose, nerve disorders, hypersensitivity and odour and taste symptoms.

Volatile pollutants

Chemical vapours known as volatile organic compounds (VOCs) are major contributors to indoor air pollution and a cause of ‘sick building syndrome’ – persistent ill-health and time off taken by workers who are affected by their toxic work environment.

VOCs can be released by photocopiers, carpets, paint and office furnishings either when they are new or when the substances in them oxidise. A notable airways irritant, formaldehyde, is emitted by many kinds of office equipment, including laminated wood, chipboard and plastic-coated furniture and wall covers. It also evaporates from paints, varnishes and chemicals used for sealing. Tobacco smoke is another well-known source of high levels of VOCs. Sick building syndrome is estimated to cost the Australian economy over \$12 billion a year in healthcare and lost production.

For the same reasons, many homes today suffer from indoor air pollution at levels far higher than their inhabitants would encounter on the street, even in a polluted city. The US EPA has found indoor concentrations of VOCs to be generally 2–5 times higher than in outdoor air and on occasion up to 1000 times higher! Furnishing, paint, carpets, cleaning agents and solvents are the major sources, but so are wood preservatives and pest treatments. Items made of plastic often contain VOCs, but these do not emerge unless the plastic is warmed: summer can sometimes be the worst time for indoor air pollution, especially in climates where people keep buildings tightly closed in order to air condition them.

The quality of indoor air has major implications for our health and wellbeing

Other forms of indoor air pollution include nitrogen dioxide and carbon monoxide from the burning of fossil fuels or wood, asbestos particles (formerly used for insulation), radon gas (in areas with high levels of uranium in the soil), methane gas and poorly maintained air conditioning systems.

POLLUTANT	MAJOR SOURCE(S)	HEALTH EFFECTS
Nitrogen dioxide	gas combustion	chronic respiratory disease
Carbon monoxide	kerosene, gas and solid fuel combustion, cars idling in an enclosed garage, cigarette smoke	aggravation of cardiovascular disease, poor foetal development
Formaldehyde	pressed wood products, consumer products, hobby crafts	eye, nose and throat irritation
Volatile organic compounds (VOCs)	new building products, cleaning products, office equipment, consumer products	eye, nose and throat irritation, headache, lethargy
Passive smoke	tobacco smoking	eye, nose and throat irritation, aggravation of asthma, chronic respiratory disease, lung cancer
House dust mite allergens	dust mites in bedding, carpets, furniture	aggravation of asthma, nasal inflammation, eczema
Mould spores	bathrooms, damp rooms, window sills, indoor plants, poorly ventilated areas	aggravation of asthma, nasal irritation and inflammation
Lead in indoor dust	pre-1970s paint, hobbies,	poor childhood intellectual development
Pet dander	cats and dogs	aggravation of asthma and hayfever

Testing indoor air

Assessment of IAQ involves collecting air samples, samples from walls, furniture or air conditioning systems and computer modelling of the air flow inside buildings. These samples are analysed for toxic chemicals, moulds or disease-causing organisms. Often this analysis will point to the source of the pollution and to a way of dealing with it. In the case of toxic furnishings they can be replaced. In the worst cases however, buildings may have to be stripped or even replaced.

Cleaning indoor air

There is a wide range of methods for dealing with indoor air pollution, including scrubbing (purifying) it with filters made with activated charcoal or other substances which bind the pollutants, allowing them to be collected for treatment or destruction. Organic pollutants can also be made harmless by breaking them down using chemical catalysts or filters containing special microbes, which generally reduce them to innocuous substances such as CO₂ and water.

CRC CARE's role

CRC CARE carries out strategic research into aspects of indoor air quality and the clean-up of contaminated air. These include research into novel methods of photocatalytic oxidation – the use of light and chemical catalysts to degrade toxic molecules in indoor air – and adsorption, where the toxic particles are trapped on surfaces of a filter. Both techniques are expected to contribute to the development of highly efficient new air filtration systems capable of overcoming the main forms of indoor air pollution, especially in large buildings.

The CRC is also working on ways to reduce risk to the public in the event of release of toxic chemicals in large public buildings, with a view to developing better emergency responses and building protection protocols. To do this, tracer gas is released in iconic and typical buildings and its dispersion is monitored, especially in stair wells and escape routes.

CRC CARE is a partnership of organisations providing research, technologies and knowledge in assessing, preventing and remediating contamination of soil, water and air.

Established and supported under the Australian Government's Cooperative Research Centres Programme



Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE)

University of South Australia
Mawson Lakes
SA 5095 Australia

P.O. Box 486
Salisbury South
SA 5106 Australia

Tel: +61 (0) 8 8302 5038
Fax: +61 (0) 8 8302 3124
Email: admin@crccare.com
Web: www.crccare.com